Appendix I.
Lower Clear Creek Conceptual Plan

CONCEPTUAL PLAN FOR RESTORATION OF THE LOWER CLEAR CREEK FLOODWAY

PREPARED FOR:
THE LOWER CLEAR CREEK TECHNICAL WORK GROUP

JUNE 1999

BACKGROUND

Land use, beginning with the discovery of gold at Reading Bar in 1848, and continuing today with gravel mining and flow/sediment regulation at Whiskeytown Dam, has profoundly changed the landscape of the lower Clear Creek watershed. These land uses, while providing tremendous benefits to society, have unfortunately caused severe damage to biological habitats provided by the creek. Recent and continuing restoration efforts are attempting to reverse these negative impacts on the creek by restoring the Clear Creek watershed. Restoration activities include adding spawning gravel, removing fish barriers, controlling erosion, reducing fuel loads and improving streamflows. The following summary describes focused efforts that will be undertaken in the next several years to restore two large sections of the lower Clear Creek floodway. The Proposed Action will complement future restoration actions that are necessary to recreate a natural stream channel and floodplain throughout the lower sections of the Creek

RESTORATION FUNDING SOURCES

In response to declining fishery populations Congress passed the Central Valley Project Improvement Act (CVPIA). One of the primary purposes of the CVPIA is to protect, restore and enhance fish, wildlife and associated habitats in the Central Valley and Trinity River Basins of California. CVPIA targets actions necessary to improve salmonid populations in Clear Creek and provided funding to develop plans and conduct environmental evaluations necessary to implement this restoration effort.

The mission of the CALFED Bay-Delta Program, which is providing most of the funding for this project, is to develop a long-term comprehensive plan that will restore ecosystem health and improve water management for beneficial uses on the Bay-Delta system. The Lower Clear Creek Floodway Restoration Project is consistent with the ecological process objectives of the CALFED Bay-Delta Program and, in 1998, the Western Shasta County Resource Conservation District was awarded a CALFED grant to initiate construction actions necessary to restore the lower Clear Creek floodway as described in this conceptual plan.

BLM's Redding Resource Area Office is also funding restoration efforts with in the lower Clear Creek Floodway. BLM funds target acquisition of important parcels in the floodway and restoration of lands degraded by mining activities through creation of additional wetlands.

AGENCY AND STAKEHOLDER PARTICIPATION
The Lower Clear Creek Channel Restoration Team is:
Western Shasta Resource Conservation District (WSRCD)
California Department of Fish and Game (CDFG)
California Department of Water Resources (DWR)
U.S. Bureau of Reclamation (USBR)
U.S. Fish and Wildlife Service (USFWS)
Bureau of Land Management (BLM)
Natural Resources Conservation Service (NRCS)
National Park Service (NPS)
Wester Area Power Administration (WAPA)
Northern California Power Administration (NCPA)

Support for the project is also provided by:
Central Valley Water Users Association
Shasta County
Shasta College
Clear Creek Coordinated Resource Management and Planning Group
Horsetown Clear Creek Preserve.

GEOGRAPHY OF CLEAR CREEK

Clear Creek originates on the eastern side of the Trinity Alps and flows south to its eventual confluence with the Sacramento River. Clear Creek channel morphology varies from steep confined bedrock reaches above Clear Creek Road bridge to wide meandering alluvial reaches from the bridge to its confluence with the Sacramento River. Clear Creek is blocked by two dams: Saeltzer Dam, a small irrigation diversion dam located six miles upstream of the Sacramento River confluence, and Whiskeytown Dam, a large storage/diversion dam located approximately 16 miles upstream of the Sacramento River confluence. Whiskeytown Dam is operated by the US Bureau of Reclamation as part of the Trinity River Division of the Central Valley Project, and is responsible for regulating streamflows to lower Clear Creek.

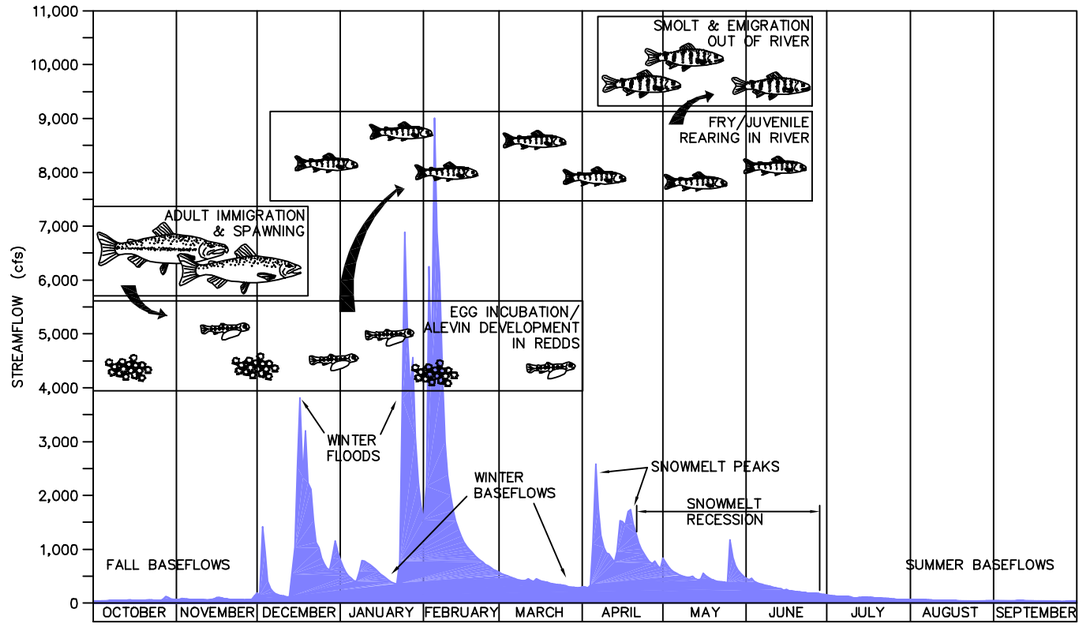
HISTORICAL NATURAL CONDITIONS ON CLEAR CREEK

The lower eight miles of Clear Creek, after it exits the canyon, are predominately alluvial, meaning that the bed and banks of the channel are formed of sand and gravel rather than bedrock. Alluvial channels similar to Clear Creek were historically very dynamic, due in large part to highly variable streamflows. Using pre-Whiskeytown Dam streamflows as an indicator of historic unimpaired flows, some key stream characteristics can be highlighted:

- **Summer baseflows**: Flows in lower Clear Creek were typically less than 50 ft^3/sec, and resulting high water temperatures forced remaining salmonids to seek refuge in colder tributary streams and headwater sections located further up the creek. Most juvenile chinook salmon migrated downstream to the delta and ocean environment in the spring before higher water temperatures and summer low flows occur.

- **Fall/winter floods**: Small to extremely large floods resulting from rainfall or rain-on-snow events provided flows for adult salmonids to migrate into and up Clear Creek. Fall/winter baseflows between storm events provided flows for adult spawning and fry rearing. The moderate and large fall/winter storm events (4,000 to 10,000 ft^3/sec) were responsible for mobilizing gravels, depositing gravels, creating floodplains, and causing the channel to migrate across the valley bottom. During extremely large flood events (10,000 to 30,000 ft^3/sec), the channel often jumped across the valley bottom, usually reshaping the channel and stands of riparian vegetation within the valley walls.

- **Snowmelt peak**: Because most of the Clear Creek watershed is below the typical snowline elevation (4,000 ft), snowmelt peaks were less than 2,000 ft^3/sec. These flows provided adequate flows and water temperatures for juvenile salmonid rearing habitat. Juvenile outmigration to the ocean also coincided with snowmelt runoff in Clear Creek and the Sacramento River.

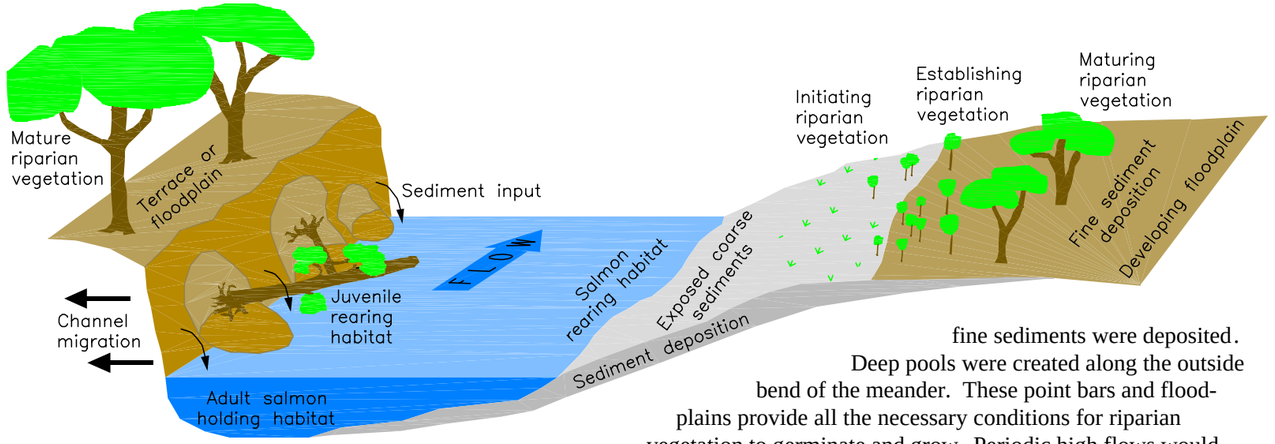


IMPORTANCE OF CLEAR CREEK TO SALMON AND STEELHEAD TROUT

Clear Creek is the first large tributary downstream of Shasta Dam, making it an important stream for salmon and steelhead production. Historically, several distinct runs of chinook salmon and steelhead trout inhabited Clear Creek. These species are anadromous, meaning they spawn in fresh water, migrate to the sea as juveniles, grow large and mature at sea before returning to their natal streams to spawn. Chinook salmon typically spawn in the fall, depositing eggs in gravel substrates in run and riffle habitats. The female digs a pit (redd) in the gravel, and as she deposits her eggs, the male fertilizes them. The eggs incubate and develop into fry under the gravel, and emerge in the late winter and spring. Young salmon rear in slow edgewater and backwater habitats during the spring, then migrate downstream with snow melt runoff to the sea in late spring. Steelhead differ from chinook salmon in that they typically spawn in winter and spring and young steelhead spend between one to four years rearing in freshwater before migrating downstream to the sea usually in the early spring. The proposed channel restoration project described in this summary acknowledges the importance of these natural environmental conditions to salmonid production and incorporates these conditions into restoration efforts.

RIPARIAN WILDLIFE COMMUNITIES

Restoration of functional, frequently flooded riparian habitats along lower Clear Creek will provide a greater diversity of riparian habitat types and stages. Conversion of marginal upland habitats that are currently dominated by tailing piles to large diverse wetland habitats will greatly enhance wildlife habitat values. Increased habitat diversity will in turn provide additional micro-habitats that are used by many wildlife species for all, or portions of their life stages.



Winter storms were very important for creating and maintaining a healthy Clear Creek floodway. These flows transported sediments (cobbles, gravel, sand, silts) from the upper watershed downstream, much of which was deposited in the valley reaches downstream of Clear Creek Road bridge. This pattern of sediment transport and deposition created alternating bars and floodplains. The creation of gravel and cobble bars forced the creek channel to meander back and forth across the valley floor. During high flows the creek eroded banks on the outside bends of the meander and deposited sediments on the inside curve of the creek forming bars. Over time these point bars slowly evolved into floodplains as fine sediments were deposited. Deep pools were created along the outside bend of the meander. These point bars and floodplains provide all the necessary conditions for riparian vegetation to germinate and grow. Periodic high flows would scour and kill some patches of riparian vegetation, while enhancing others by placing new soil deposits along the floodplain. This pattern of damage and regrowth resulted in diverse stands of riparian vegetation, and created a wide range of terrestrial and aquatic habitats important for native fish and wildlife species.

In short, the natural pattern of high flows, low flows, and sediment supply combined to create a dynamic and diverse lower Clear Creek floodway, which in turn supported substantial populations of salmon, steelhead and other native wildlife species. Human induced changes to Clear Creek, beginning in 1848 with the discovery of gold at Reading Bar, initiated substantial changes to the floodway, leading to our present need to restore degraded reaches.

HISTORIC USE IMPACTS

Recalling that the interaction of streamflows and sediment create and maintain a healthy Clear Creek floodway, any changes to the balance of streamflow and sediment induce a change to the floodway, and many of the native species that inhabit it. Some of the more important changes are described below.

1848 Gold Discovery

Gold was discovered along the banks of Clear Creek in 1848, and was the first of many actions that lead to the decline of salmon and steelhead populations. Placer mining altered the stream channel and increased erosion of sediments into the channel degrading salmon and steelhead habitats. Once placer miners exhausted surface gold deposits, several hydraulic cannons were brought into the watershed to gain access to subsurface gold deposits along the stream banks and hillsides. The devastation caused on by these hydraulic cannons on the landscape prompted passage of California's Anti-Debris Act in 1883 outlawing the use of hydraulic cannons.

Large Dredging in the Early 1900's

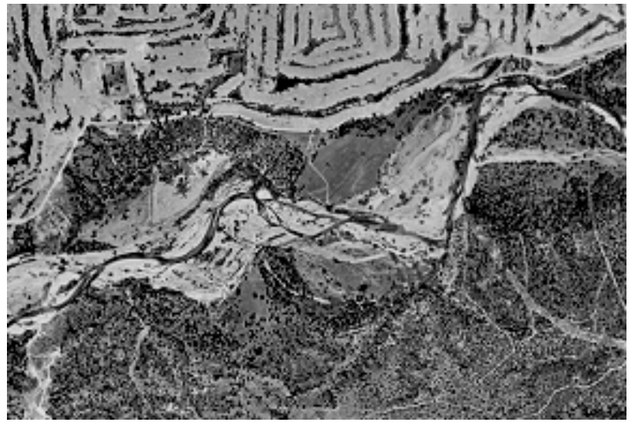
Large floating dredges began working the lower reaches of the creek channel and tributary streams during the early years of the twentieth century. Operation of these dredges throughout the lower reaches of the creek caused massive alterations to the natural morphology of the stream channel and ecosystem further degrading salmon and steelhead habitats.

Saeltzer Dam, 1903 to Present

Saeltzer Dam was first constructed in 1903 by the Townsend Flat Water Ditch Company to provide water for agriculture, livestock, and land development businesses in the area. The dam, located about 6 miles upstream of the Sacramento River creates a migration barrier for salmon and steelhead eliminating access to valuable spawning and rearing habitat. Several attempts have been made to provide fish passage over the dam without success. In response, both the Central Valley Project Improvement Act and the CALFED Bay-Delta Program have recognized the need to remedy the fish passage problem and efforts are underway to provide a fish friendly solution.

Gravel Extraction, 1950s through 1978

Gravel extraction operations began removing tailing piles and gravel accumulations within the lower Clear Creek floodway during the 1950's. Removal of large quantities of alluvial material (gravel, cobble and sand) has seriously degraded the natural functioning condition of the stream channel and floodplain. The combination of sediment reduction from upstream dams and instream gravel extraction has lowered the elevation of the creek to the point where much of the channel bottom rests on clay hardpan or bedrock. Gravel extraction also removed floodplains, created braided channels, and left several large open pits within the channel and floodway. Fry and juvenile salmon become trapped in these open off channel pits during periods of fluctuating flow which are common during the late winter and spring rearing period. The conversion of the bed from gravel to clay hardpan also reduced the quality and area of spawning and food producing habitats within the stream channel. The area most impacted by these activities is located three miles downstream of Saeltzer Dam and the intent of this restoration project is to remedy the impacts of gravel extraction. Moreover, this restoration project is designed to remediate many of the other human land-use impacts.



Project Site 1952

Project Site 1980

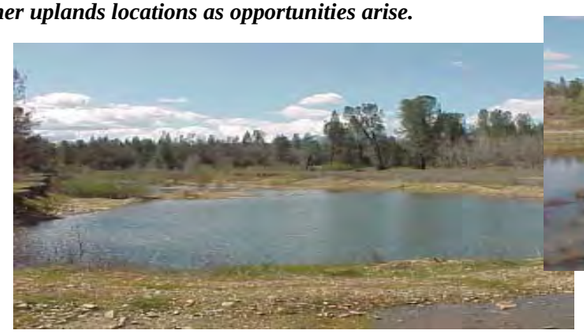
Whiskeytown Unit of the Trinity River Division, 1963 to Present

The Trinity River Division (TRD) of the Central Valley Project was authorized in 1955 to increase water supplies available for irrigation and other beneficial uses in the Central Valley. Whiskeytown Dam serves to capture Clear Creek flows and water diversions from the Trinity River through the Clear Creek Tunnel. Inflows to Whiskeytown Dam are diverted to the Sacramento River at Keswick Dam through the Spring Creek Tunnel. Regulated flow releases combined with the elimination of sediment sources upstream further impacted available fishery habitat in lower Clear Creek by altering the natural fluvial processes that are critical to maintaining favorable habitat conditions. In recent years the Bureau of Reclamation, working cooperatively with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and California Department of Fish and Game, has provided additional flow releases to improve habitat conditions for salmon and steelhead.

LOWER CLEAR CREEK FLOODWAY RESTORATION PROJECT OBJECTIVES

The goal of the Lower Clear Creek Floodway Restoration Project is to restore floodway function and morphology to two reaches of stream that have been severely degraded by gravel extraction and gold dredger mining. At the gravel extraction site (Project site), this will be accomplished by filling old mining pits, whereas at the gold dredger mining sites (Borrow sites) this will be accomplished by removing dredger tailings for use at the Project site. At both sites, these activities will restore a properly sized bankfull channel, reconstruct functional floodplains, increase gravel supply, plant native riparian vegetation, and construct floodplain surfaces to encourage natural riparian regeneration. Because both sites are on public lands, this project will accomplish the restoration goal and reduce project costs by restoring two sites for the price of one. These borrow areas also provide opportunities to restore other floodplain surfaces and enhance upland habitats through creation of new wetlands. Our specific objectives for restoration are:

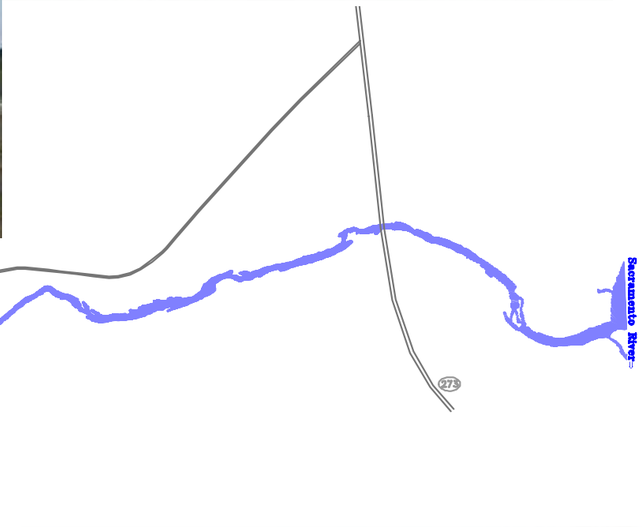
- ***Reverse channel damage caused by historic gravel extraction at the Project site by reconstructing a properly sized bankfull channel and floodplain.***
- ***Restore the ability of the channel to route coarse sediment downstream and deposit fine sediment on floodplain surfaces.***
- ***Restore native riparian vegetation on floodplain surfaces by focusing on species that provide a diverse canopy structure and removing competing exotic plant species.***
- ***Reduce salmonid stranding and mortality in floodplain gravel mining pits.***
- ***Provide improved habitat conditions for native fish and wildlife including priority salmonid species of central concern to CALFED and CVPIA restoration programs.***
- ***Create diverse off channel wetland habitats in marginal upland habitats that are currently degraded by dredger tailings and in other uplands locations as opportunities arise.***



ECOSYSTEM RESTORATION VISION

River ecosystem health is dependent to a large degree on the physical processes that occur within the watershed. In aquatic systems, fish and wildlife species are even more dependent on the physical condition of their environment for survival, growth and reproduction. Native fish, wildlife, and plant species have evolved over the millennia to best survive under those natural physical conditions. Restoration of the lower Clear Creek floodway is based on the premise that salmon and trout habitat is best restored and maintained by recreating those natural conditions, flow and sediment transport, within the current physical and operational constraints that exist within Clear Creek today. Given these conceptual ideas the Lower Clear Creek Channel Restoration Team developed the following vision statement to guide development of future restoration actions within lower Clear Creek:

Utilize an integrated approach to re-establish critical ecological functions, processes, and characteristics, within contemporary regulated flow and sediment conditions, that best promote recovery and maintenance of resilient wild salmon populations and the river's natural animal and plant communities.



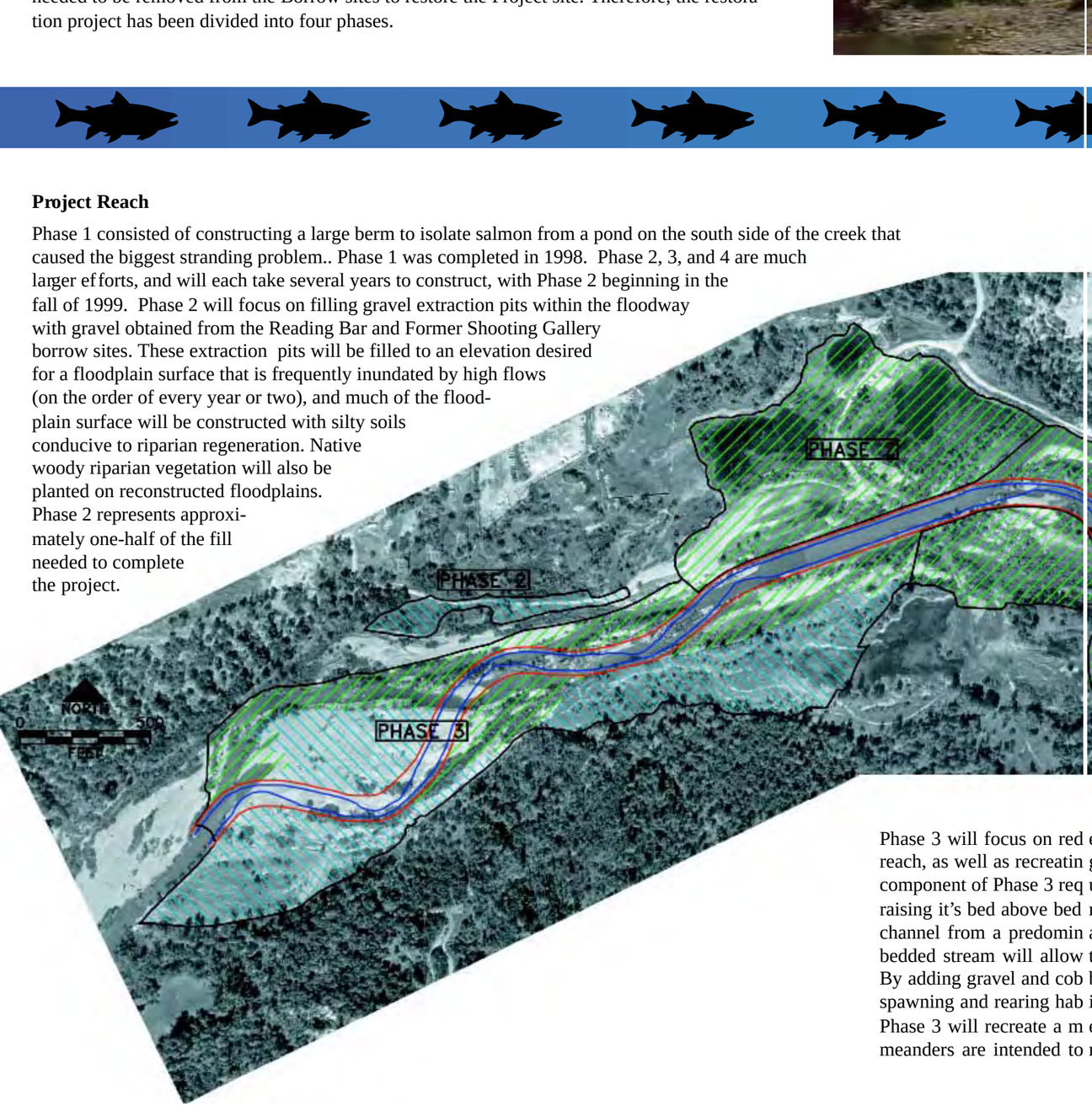
MAJOR PROJECT FEATURES

Extensive gravel mining at the Project site left a series of pits and reaches of channel with exposed clay hardpan, and in some locations, diverted the channel from its natural location into artificial bypass channels. Destruction of a defined channel resulted in many multi-channeled reaches that caused significant stranding mortality to both adult and juvenile salmon. Restoring this site requires that much of the gravel removed during mining activities be replaced to redefine a primary channel and floodplain. The scale of restoring these sites is largely due to the extensive volume of gravel removed from the Project site, and the large volume of gravel needed to be removed from the Borrow sites to restore the Project site. Therefore, the restoration project has been divided into four phases.

Phase 4 will restore Clear Creek to its pre-gravel mining location in the downstream end of the project site. Presently, Clear Creek flows through an artificially constructed bypass channel through clay and bedrock, bisecting its natural meandering channel. In addition to moving the channel back to its historic location, floodplains will be reconstructed, and native woody riparian vegetation will be replanted.

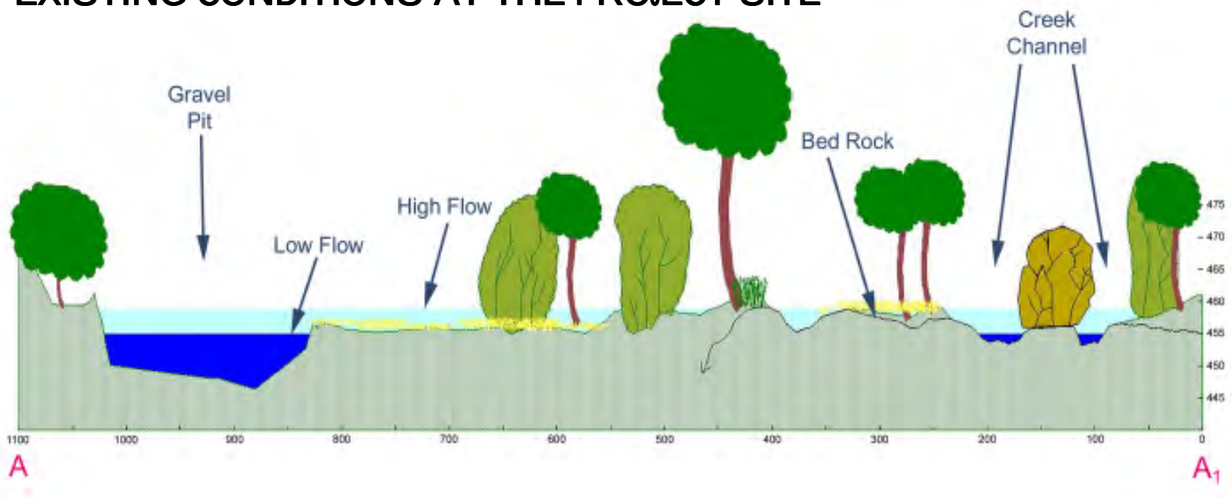
Project Reach

Phase 1 consisted of constructing a large berm to isolate salmon from a pond on the south side of the creek that caused the biggest stranding problem.. Phase 1 was completed in 1998. Phase 2, 3, and 4 are much larger efforts, and will each take several years to construct, with Phase 2 beginning in the fall of 1999. Phase 2 will focus on filling gravel extraction pits within the floodway with gravel obtained from the Reading Bar and Former Shooting Gallery borrow sites. These extraction pits will be filled to an elevation desired for a floodplain surface that is frequently inundated by high flows (on the order of every year or two), and much of the floodplain surface will be constructed with silty soils conducive to riparian regeneration. Native woody riparian vegetation will also be planted on reconstructed floodplains. Phase 2 represents approximately one-half of the fill needed to complete the project.



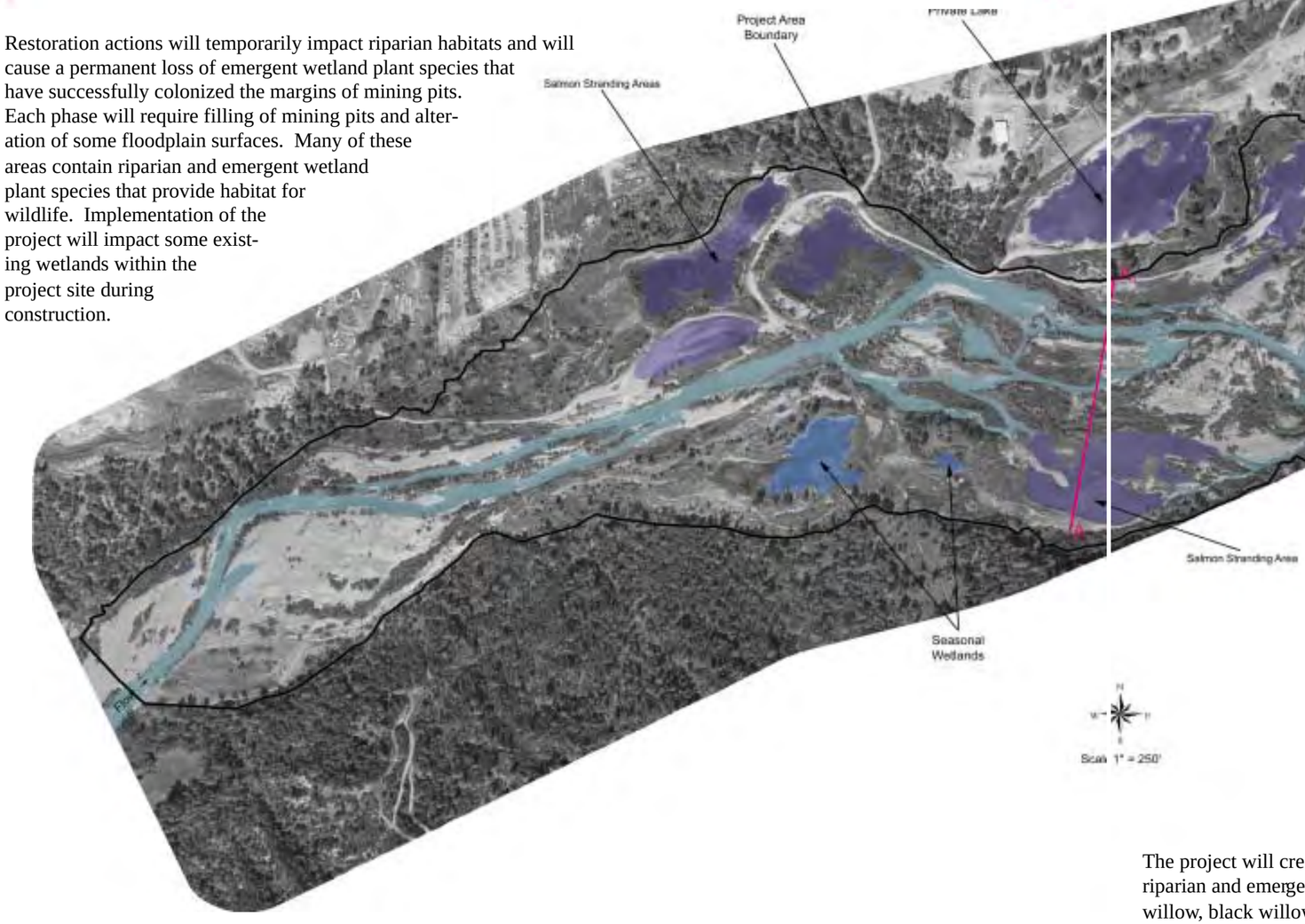
Phase 3 will focus on redefining a primary channel through the upper two-thirds of the reach, as well as recreating floodplain surfaces and riparian revegetation. A critical component of Phase 3 requires moving the new channel away from bedrock areas, and raising it's bed above bedrock surfaces by adding gravels and cobbles. Converting the channel from a predominately bedrock bottomed stream back to a gravel and cobble bedded stream will allow the channel to create bars and move across the floodway By adding gravel and cobbles back to the channel, most of the instream habitat (salmon spawning and rearing habitat) will be created during Phase 3 of the project. Most of Phase 3 will recreate a meandering channel with a series of pools and riffles, and these meanders are intended to move and readjust during high flows.

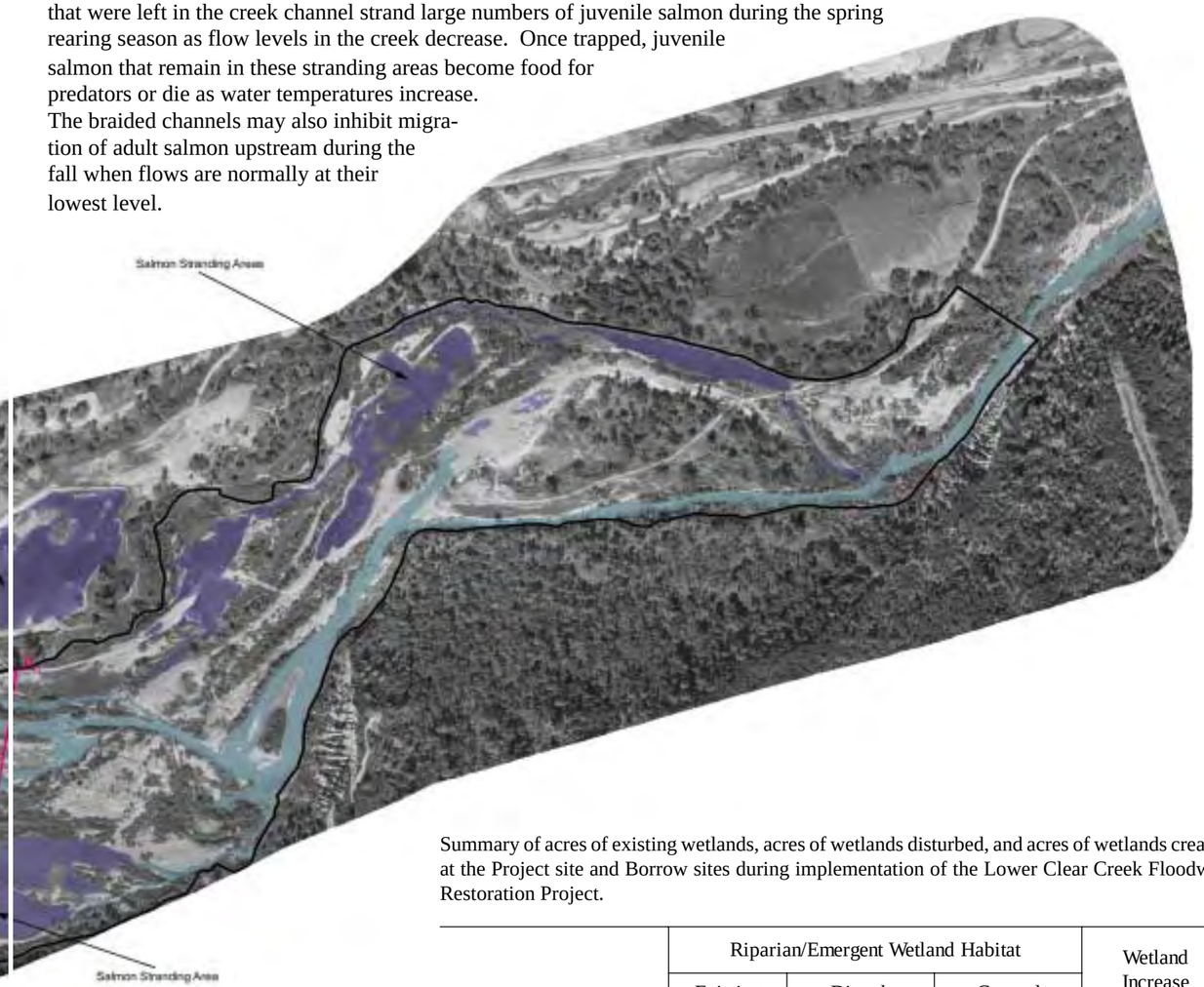
EXISTING CONDITIONS AT THE PROJECT SITE



Restoration actions will temporarily impact riparian habitats and will cause a permanent loss of emergent wetland plant species that have successfully colonized the margins of mining pits. Each phase will require filling of mining pits and alteration of some floodplain surfaces. Many of these areas contain riparian and emergent wetland plant species that provide habitat for wildlife. Implementation of the project will impact some existing wetlands within the project site during construction.

Years of gravel extraction within the Project Reach have removed vast quantities of alluvial gravel deposits that are critical to maintaining healthy habitat for salmon and steelhead. Riffle habitats that once contained abundant spawning gravels have been replaced by clay and bedrock surfaces that are unsuitable for spawning. Remnant gravel mining pits that were left in the creek channel strand large numbers of juvenile salmon during the spring rearing season as flow levels in the creek decrease. Once trapped, juvenile salmon that remain in these stranding areas become food for predators or die as water temperatures increase. The braided channels may also inhibit migration of adult salmon upstream during the fall when flows are normally at their lowest level.





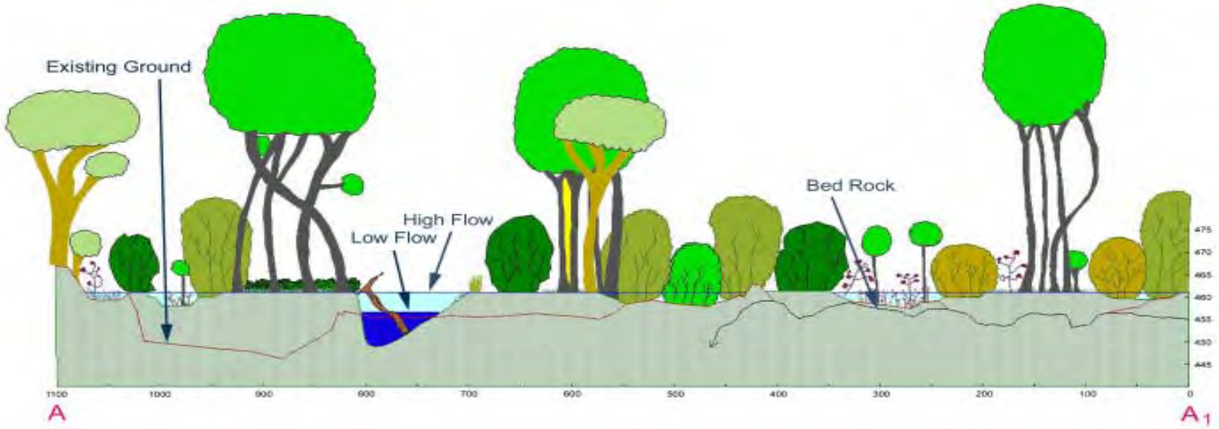
Summary of acres of existing wetlands, acres of wetlands disturbed, and acres of wetlands created at the Project site and Borrow sites during implementation of the Lower Clear Creek Floodway Restoration Project.

Location	Riparian/Emergent Wetland Habitat			Wetland Increase (acres)
	Existing (acres)	Disturb (acres)	Created (acres)	
Project Site (Phase 2-4)	88.6	52.2	77.2	25.0
Borrow Sites				
Reading Bar	4.3	0.9	7.9	7.0
Former Shooting Gallery	6.8	4.4	13.6	9.2
Old Mill[1]	6.9	5.0	32.4	27.4
Total	106.6	59.1	125.7	65.6

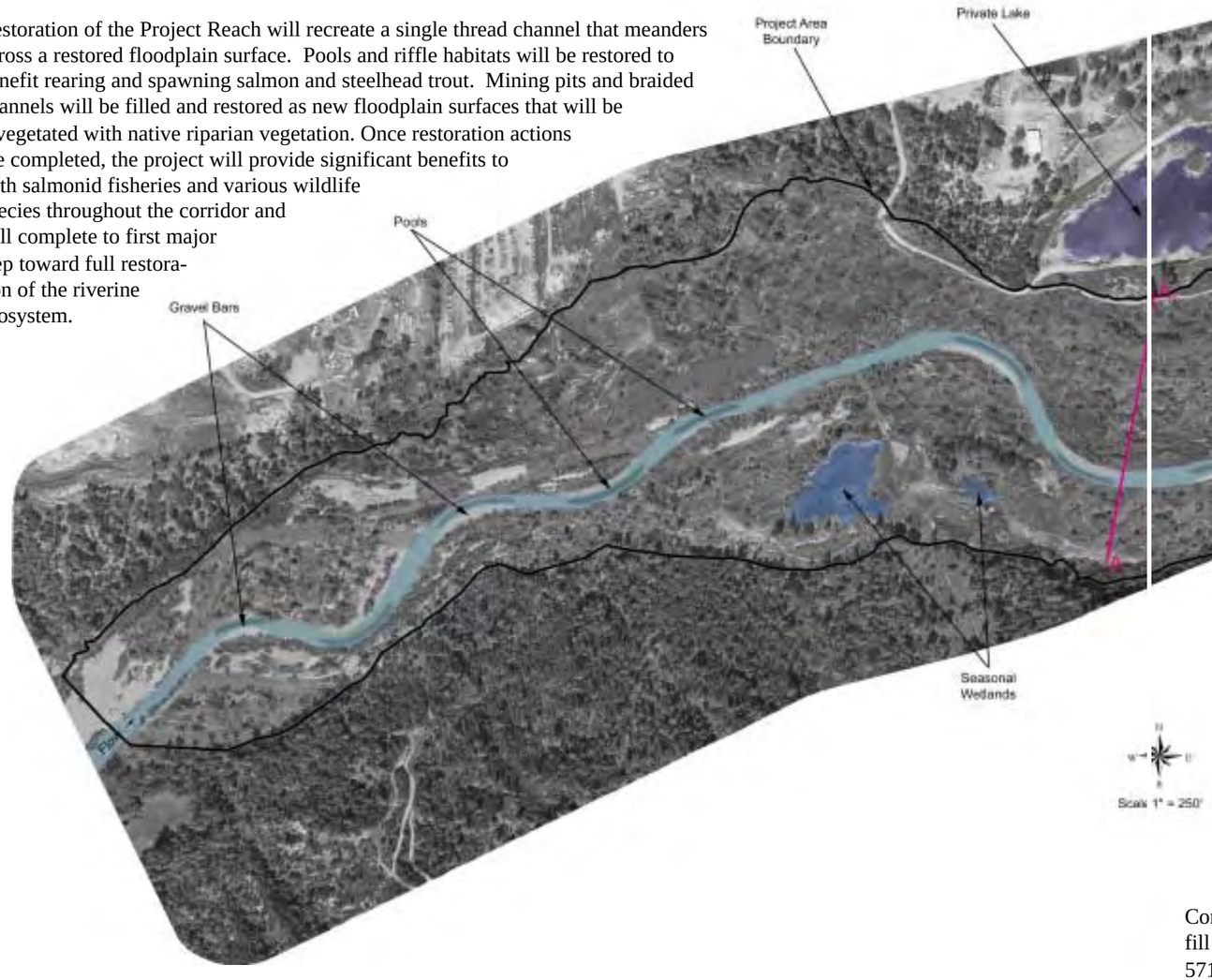
[1] Wetland estimates include 6 acres Phase 1 mitigation and Abandoned Mines Restoration effort by BLM.

The project will create additional riparian wetlands on newly created floodplains in the project site and will create additional riparian and emergent wetlands in each of the three borrow sites upstream. Vegetation communities to be restored include Arroyo willow, black willow, mixed willow, white alder, Fremont cottonwood, bulrush, buttonbush, elderberry, mulefat, and sedges. Planting various vegetation communities will insure creation of diverse wildlife habitats and will restore floodplain surfaces to historic conditions.

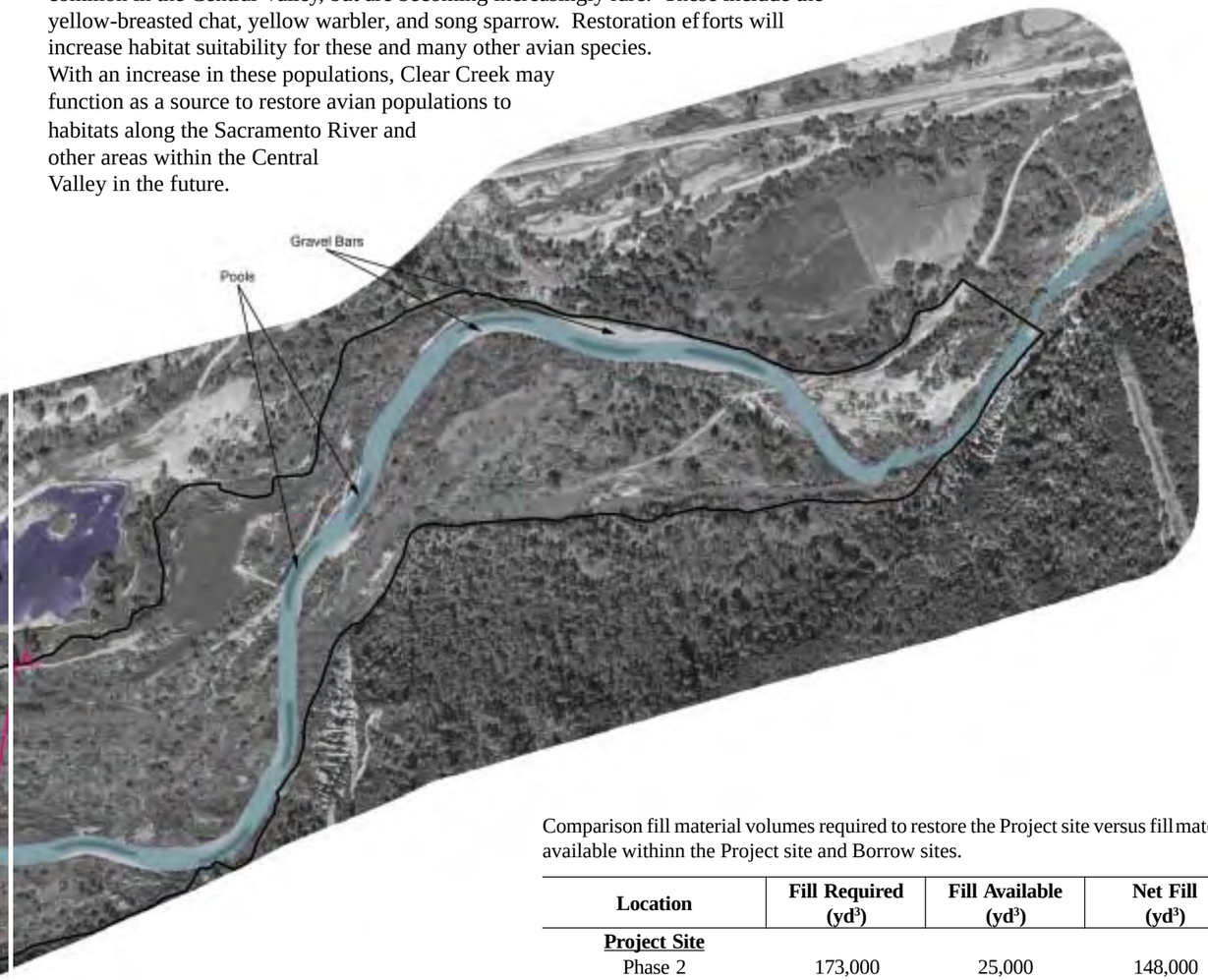
RESTORED CONDITIONS AT THE PROJECT SITE



Restoration of the Project Reach will recreate a single thread channel that meanders across a restored floodplain surface. Pools and riffle habitats will be restored to benefit rearing and spawning salmon and steelhead trout. Mining pits and braided channels will be filled and restored as new floodplain surfaces that will be revegetated with native riparian vegetation. Once restoration actions are completed, the project will provide significant benefits to both salmonid fisheries and various wildlife species throughout the corridor and will complete to first major step toward full restoration of the riverine ecosystem.



Clear Creek currently supports breeding populations of several migratory bird species that were once common in the Central Valley, but are becoming increasingly rare. These include the yellow-breasted chat, yellow warbler, and song sparrow. Restoration efforts will increase habitat suitability for these and many other avian species. With an increase in these populations, Clear Creek may function as a source to restore avian populations to habitats along the Sacramento River and other areas within the Central Valley in the future.

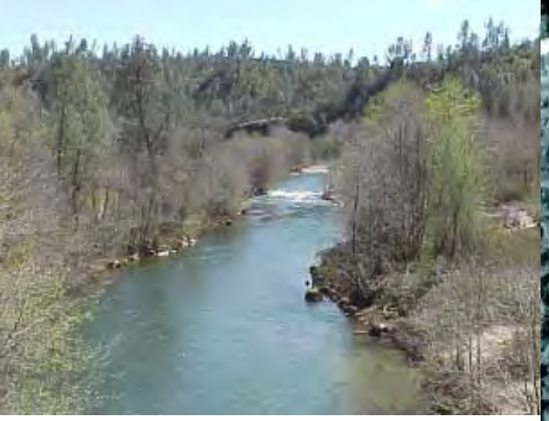


Comparison fill material volumes required to restore the Project site versus fill material available withinn the Project site and Borrow sites.

Location	Fill Required (yd^3)	Fill Available (yd^3)	Net Fill (yd^3)
Project Site			
Phase 2	173,000	25,000	148,000
Phase 3	242,051	132,095	110,000
Phase 4	156,000	41,000	114,000
Subtotal	571,000	198,000	372,000
Borrow Sites			
Reading Bar		120,000	252,000
Former Shooting Gallery		310,000	(58,000)
Old Mill[1]			
Subtotal		430,000	
Total Surplus			+58,000

[1] Materials from Old Mill site are not required for phase 2-4 implementation

Construction of the project will require movement of large volumes of material (dredger tailing and existing floodplain surfaces) to fill pits and create a new stream channel and floodplain surfaces. Construction of the entire project will require approximately 571,000 yd^3 . Approximately 198,000 yd^3 of material is available within the project site in historic flood terraces and 430,000 yd^3 of material are available at the Reading Bar and Former Shooting Gallery Borrow Sites leaving a surplus of approximately 58,000 yd^3 of material.

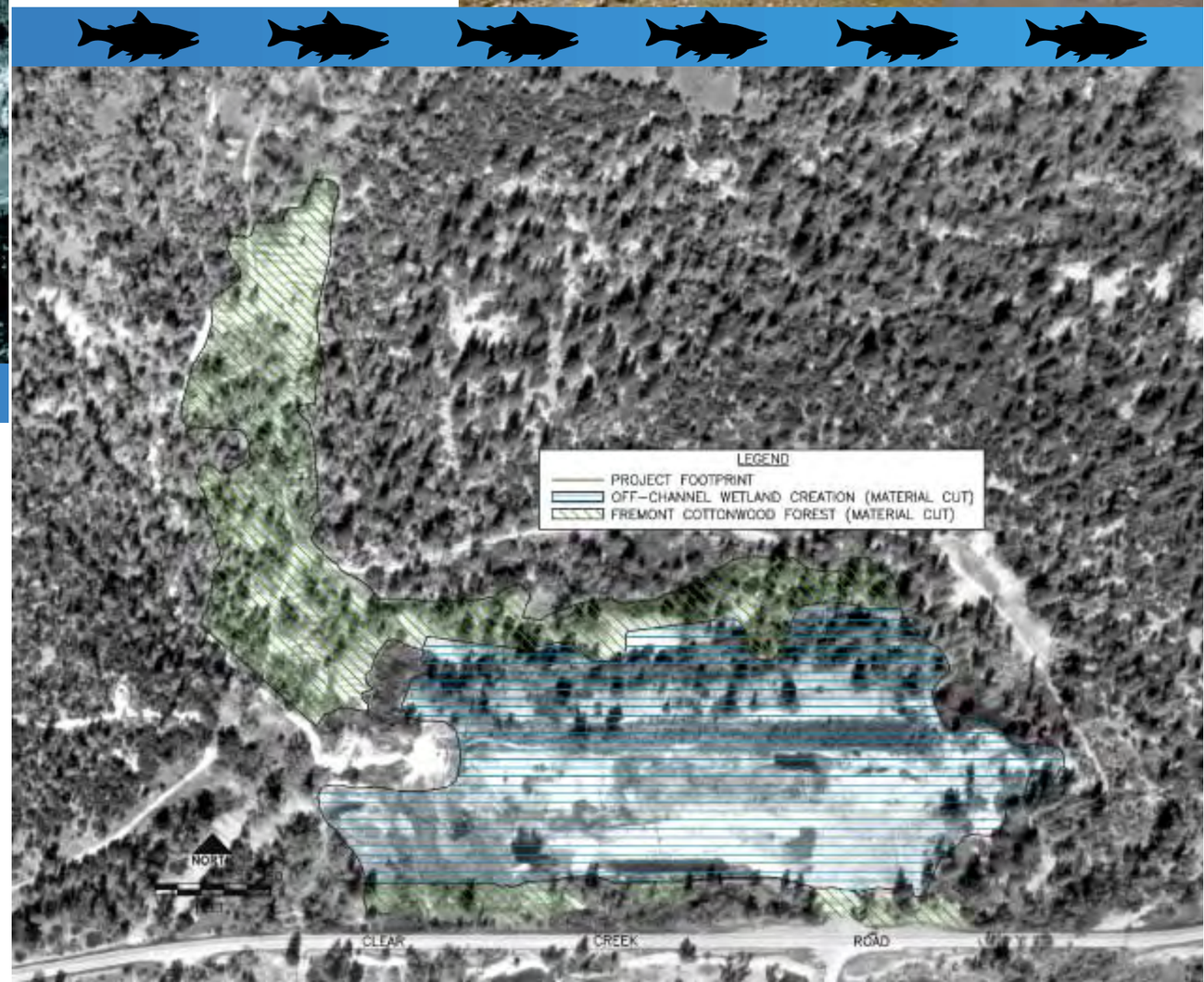


Borrow Sites

Constructing Phase 2-4 will require large volumes of cobble and gravel. Two sites with extensive dredger tailings on public land have been identified as the best sources of cobbles and gravels: Reading Bar and the Former Shooting Gallery. A third site, Old Mill, was identified as a good location to create and enhance upland habitats through creation of off channel wetlands. These sites are all within a few miles of the Project site, and using these borrow sites will provide economical sources of gravel and cobbles. Fill material will be obtained by excavating dredger tailings. Because the Reading Bar site is adjacent to Clear Creek, dredger tailings will be removed to an elevation that creates a new floodplain surface over most of the site, and off-channel wetlands will be created further away from the channel.

The Old Mill Site provides a good location for creation of additional wetland habitats and six acres of riparian emergent wetlands will be created on this site as mitigation for wetland losses incurred at the Project Site during implementation of Phase 1 in 1998. The Bureau of Land Management has also selected this site for creation of up to an additional 20 acres of wetlands using funds obtained through their Abandoned Mines Restoration Program.

The Former Shooting Gallery is isolated from Clear Creek, thus dredger tailings and surface fill material at these sites will be excavated to create off-channel wetlands. Off-channel wetlands will be designed and constructed to provide a diversity of habitat types which include shallow fresh water emergent vegetation, wet meadows, woody riparian communities and open water areas.

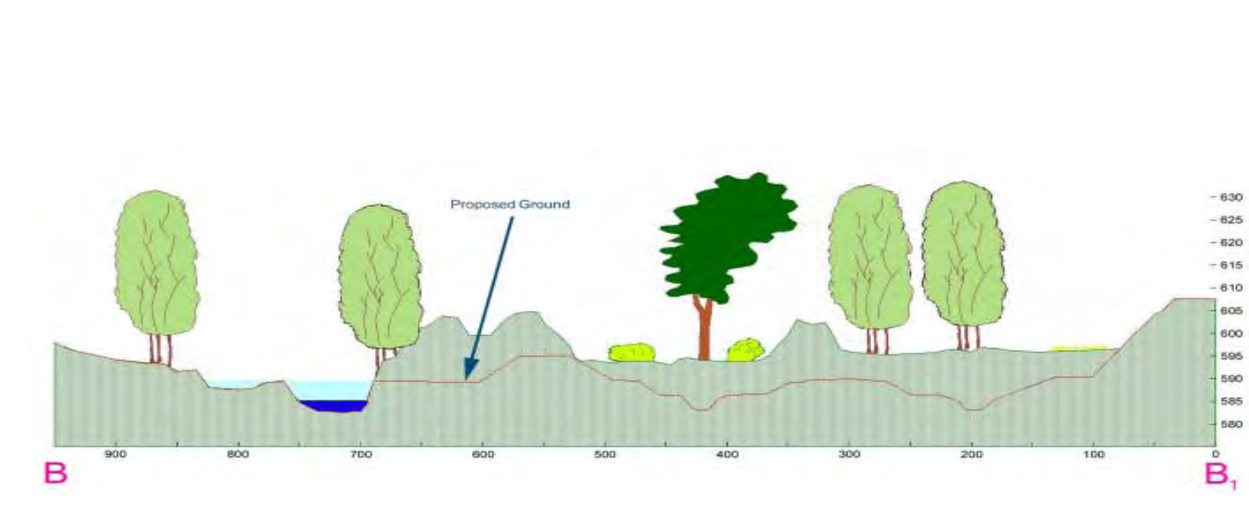


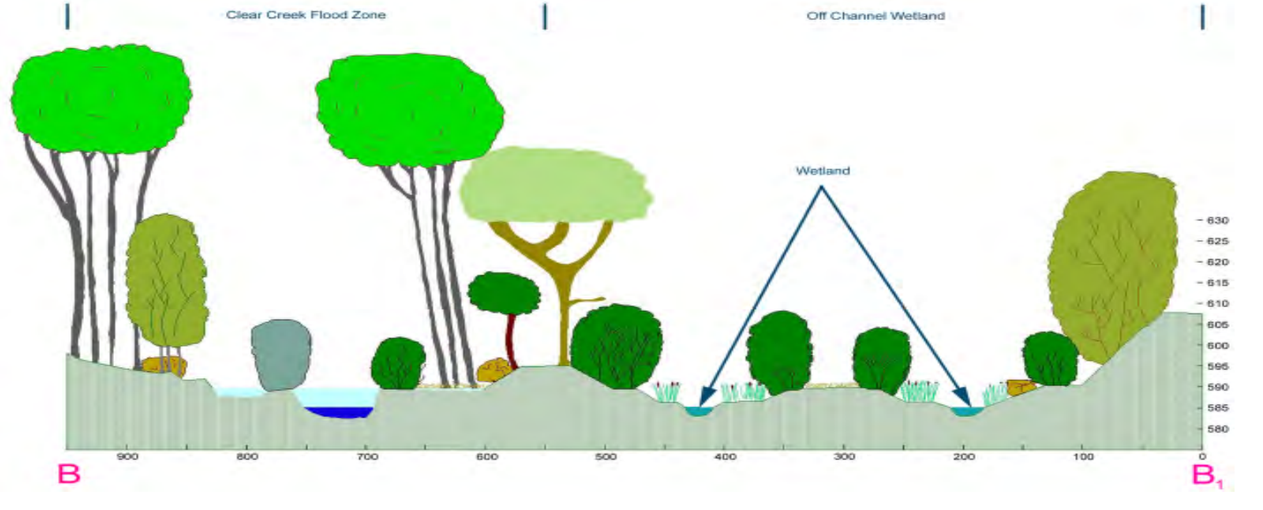
EXISTING CONDITIONS AT THE READING BAR SITE

RESTORED CONDITIONS AT THE READING BAR SITE

The Reading Bar Site has been altered by both gold miners and gravel mining operators and provides a good source of borrow material needed for restoratio n of the Project Site downstream. Because the Reading Bar site is adjacent to Clear Creek, dredger tailin gs will be removed to an elevation that creates a new floodplain surface over most of the site.

Off-channel wetlands will be created further away fr om the channel in an area that currently provides little wildlife habitat value. Restored floodplain surfaces and off-channel wetlands will be revegetated with native riparian and wetland species which will provi de greater benefits to wildlife species. By integrating the removal of borrow materials with restoration acti ons, the project will reduce costs and accomplish restoration goals at the Borrow Sites and Project Site simultaneously.





CONCEPTUAL PLAN FOR RESTORATION OF THE LOWER CLEAR CREEK FLOODWAY

PREPARED FOR:
THE LOWER CLEAR CREEK TECHNICAL WORK GROUP

PREPARED BY:

McBain & Trush
P.O. Box 663
Arcata, CA 95518
(707) 826-7794

North State Resources
Northstate Reources
5000 Bechelli, Suite 203
Redding, CA 96002
(530) 222-5347

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